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The water quality standards program is the first nationwide strategy for water quality management. It contains four major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the interstate water; criteria to pretect those uses; implementation plans (for needed industrial-municipal waste treatment improvements) and enforcement plans; and an antidegradation statement to protect existing high quality waters. Temperature standards are set to control thermal pollution, or the amount of heated wastes discharged into the water.

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ENVIRONMENTAL PROTECTION AGENCY
Office of Water Programs

Temperature

Division of Water Quality Standards
Washington, D. C.
March 1971

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The water quality standards program is directed by the Environmental Protection Agency, an independent regulatory agency which has responsibility for approving State-adopted standards, evaluating adherence to the standards, and overseeing enforcement of standards compliance.

Standards, the first nationwide strategy for water quality management, contain four major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the interstate water; criteria to protect those uses; implementation plans (for needed industrial-municipal waste treatment improvements) and enforcement plans; and an antidegradation statement to protect existing high quality waters.

Minimum water quality criteria, or numerical specifications of physical, chemical, temperature, and biological levels, are stated in the National Technical Advisory Committee report to the Secretary of the Interior, Water Quality Criteria, dated April 1, 1968, and published by the Government Printing Office, Washington, D. C. Unavailability of the NTAC report before June 30, 1967--the date set by the Water Quality Act of 1965 for formal adoption of State standards--resulted in significant variations between the State-adopted and the NTAC minimum criteria. Some standards were adopted and approved before the NTAC report became available.

The Water Quality Criteria report is presently being updated in light of new scientific and technical information, with schedule publication in June 1972. These criteria compilations are issued to provide information to the public on water quality standards. As further information becomes available, they will be updated.

Water quality standards are subject to change when justified by newly available technical and scientific information. For the latest information refer to the existing approved water quality standards which can be obtained from the individual State water pollution control agency or EPA regional office.

Temperature standards are set to control thermal pollution, or the amount of heated wastes discharged into the water. Thermal pollution creates adverse conditions for aquatic life; accelerates biological processes in the streams, reducing the dissolved oxygen content of the water; increases the growth of aquatic plants, contributing to taste and odor problems; or otherwise makes the water less suitable for fish and wildlife, domestic, industrial, and recreational uses.

Water Quality Criteria, used by EPA in evaluating State standards, recommends a maximum water temperature of 90°F with a maximum permissible rise above the naturally existing temperatures of 5°F in streams and 3°F in lakes. It recommends that trout and salmon waters not be warmed in order to protect these resources. Because of the lesser temperature fluctuations in the marine and estuarine environment, the NTAC report recommends that monthly maximum daily temperatures recorded at any site, before the addition of artificial heat, not be raised by more than 4°F from September through May and by more than 1.5°F from June through August.

Individual State-adopted standards follow.

March 30, 1971

WATER QUALITY STANDARDS SUMMARY
Temperature Criteria

Key:

PWS - Public Water Supply
Rec. - Recreation
F & WL - Fish and wildlife propagation
Agric. - Agricultural water supply
Ind. - Industrial (also may include power and cooling) water supply
Nav. - Navigation
Shell. - Shellfishing
* - not approved by Secretary

Alabama:

PWS - "With respect to cooling water discharges only, the ambient temperature of receiving waters shall not be increased more than 10°F. by the discharge of such cooling waters, after reasonable mixing; nor shall the discharge of such cooling waters, after reasonable mixing, cause the temperature of the receiving waters to exceed 93°F."

Rec. - same as PWS

Agric. and Ind. - same as PWS

Shell. - same as PWS*

F & WL - Same as PWS*

Alaska:

PWS - below 60°F.; waste flows above 60°F. adjusted to ambient receiving water temperature.

Rec. - numerical value not applicable

F & WL - may not exceed temperature of natural conditions by more than 5% for salt water or 10% for fresh water. No change permitted for temperatures over 60°F. Maximum rate of change - 0.5°F./hr.

Shell. - less than 68°F.

Stock and Irrigation - between 60°F. and 70°F. for optimum growth to prevent physiological shock to plants.

Ind. - less than 70°F.

Arizona: 93°F. max; not more than 5°F. change.

Cold water fish. - Nov.--March--55°F. max.) not more than
April-Oct.--70°F. max.) 2°F. change

Arkansas: 20°C. - max. in trout streams
30°C. - max. in smallmouth bass streams
35°C. - max. in other streams

California: Smith River - the following maxima: 60°F., Sept.-Oct.; 55°F., Nov.-May; 60°F., June; 70°F., July-Aug.*

Klamath River - the following maxima: 60°F., Oct.; 55°F. Nov.-May; 65°F., June; 70°F., July-Aug.; 65°F., Sept.*

Lake Tahoe - no criteria*, but prohibition of all waste discharges

East & West Walker Rivers and Lake Topaz - 22°C.*

East & West Forks Carson River and Truckee River - 20°C.*

Goose Lake - the mean daily temperature shall not exceed 70°F., or the mean daily ambient air temperature, whichever is greater.*

Alamo & New Rivers - temperature change less than 2°F.*

All other waters - various narrative statements which state that temperatures shall not adversely affect aquatic life or other water uses.*

Colorado Class B_1 (cold water fish) - 70°F. max. No controllable temperature change will be permitted which will interfere with the spawning and other aspects of fish life. Abrupt changes in temperature must be avoided and the normal pattern of diurnal and seasonal fluctuations must be preserved. The maximum allowable rise in temperature resulting from waste discharges in streams and the epilimnion of lakes shall be 2°F. No discharge permitted to the hypolimnion of lakes.

Class B_2 (warm water fish) - 90°F. max. No controllable temperature change will be permitted which will interfere with spawning and other aspects of fish life. Abrupt changes in temperature must be avoided and the normal pattern of diural and seasonal fluctuations must be preserved. The maximum allowable temperature increase due to waste discharge in streams will be 5°F., and the maximum increase allowable from waste discharges to the epilimnion of lakes is 3°F.

Class B_1 and B_2 - In temperature measurement, allowance shall be made for a mixing zone. Provisions shall be made for adequate mixing and no thermal barrier to migration and free movement of aquatic biota shall be permitted in any waters of the State.

Class C - Temperature - The temperature shall not exceed 93°F.

Class D - Temperature - No temperature criteria assigned.

Connecticut:

Class A (PWS) - no increase other than natural origin	
Class B (Rec.)	)No increase to exceed
Class C (F & WL)	)recommended limits on
Class D (Nav. & Ind.)	)most sensitive water
Class SA (Shell.)	)use, and in no case to
Class SB (Restricted Shell,)	)exceed 4°F. over natural
Class SC (Shell. Habitat	)with a max. of 85°F.
Class SD (Nav.)	)

Delaware: Ocean waters - shall not exceed 5°F. above normal for the area or a max. of 75°F.

Most rivers - shall not exceed 5°F. above normal for the section. (For some rivers - a max. of 85°F. or 87°F.)

District of Columbia: Not to exceed 90°F., 5°F. change limit; no sudden or localized temperature changes which may adversely affect aquatic life.

Florida: All waters - temperature shall not be increased so as to cause any damage or harm to the aquatic life or vegetation of the receiving waters or interfere with any beneficial use assigned to such waters.

(Secretary has requested changes in criteria)

Georgia:

PWS)Not to exceed 93.2°F. at any time and not to be
Rec.)increased more than 10°F. above intake tempera-
F & WL)ture. In streams designated by the State Fish and
Shell.)Game as trout waters, there shall be no elevation or depression of natural stream temperature.

Ind. not to exceed 93.2°F. at any time and not to be increased more than 10°F. above intake temperature.

Guam:

PWS - 85°F. max., 5°F. change limit, 1.5°F. hourly change limit.

Rec. - 85°F.

F & WL - 1.5°F. change limit from natural conditions.

Hawaii:

Classes AA, A, B (all uses of coastal and tidal waters) - temperature of receiving waters shall not change more than 1.5°F. from natural conditions.

Idaho:

No measurable temperature increase when stream temperature is 68°F. or above, or more than 2°F. increase when river temperature is 66°F. or less (Except 70°F. and 68°F., respectively, for Snake River - RM 407 to 247.)

Illinois:

PWS - 90°F. max.

F & WL - not to exceed 90°F., April through Nov.; not to exceed 60°F., Dec. to April*

Ind. - 90°F. max., except in SWB-8 where maximum is 93°F.

Lake Michigan - 85°F. max.

Indiana:

Industrial Classification - Temperature shall not exceed 95°F. at any time.

Aquatic Life

1. Warm water species
   a. There shall be abnormal temperature changes that affect aquatic life unless caused by natural conditions.
   b. The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.

c. The maximum temperature rise at any time or place above natural temperature shall not exceed 5°F. In addition, the water temperature shall not exceed the maximum limits indicated in the following table:

	Ohio River Main Stem	St. Joseph River Tributary to Lake Michigan	Other Indiana Streams
January	50	50	50
February	50	50	50
March	60	55	60
April	70	65	70
May	80	75	80
June	87	85	90
July	89	85	90
August	89	85	90
September	87	85	90
October	78	70	78
November	70	60	70
December	57	50	57

2. Cold Water Species

a. In trout and salmon streams where natural reproduction is to be protected, no heat shall be added.

b. In put-and-take streams, temperature shall not exceed 65°F. or a 5°F. rise above natural, whichever is less.

Iowa: Warm water fish. - 93°F., May-Nov.; 73°F., Dec.-April *

Cold Water fish. - 70°F. max. *

(Criteria only approved for Mississippi and Missouri Rivers)

Kansas: Maximum temperature 90°F.
Allowable rise for streams and rivers is 5°F.
Allowable rise for the epilimnion of lakes and reservoirs is 3°F. Temperature measurement is at the outfall and with the maximum temperature allowed at the outfall reflecting a reasonable mixing zone in the receiving waters so that the 5°F. or 3°F. rise specified is not violated in the contiguous receiving waters. Any barrier to migration and the free movement of the aquatic biota is prohibited.

Kentucky: F & WL - not to exceed 93°F., May-Nov.; not to exceed 73°F., Dec.-April.

Ind. - 95°F. max.

Min. daily allowable temperature change of 10°F., and an hourly rate not to exceed 2°F./hr. Temperature not to exceed 73°F. in Dec., Jan., and Feb. - all waters.

Louisiana: Not to be raised more than 3°C. above normal ambient water temperature, nor to exceed a max. of 36°C.

A few rivers - 2°C. rise, 35°C. max.

Maine: Freshwater (rivers, streams, and lakes) - 84°F. max. for warm water fish and 68°F. max. for trout and salmon waters. Rise of 5°F. from heated effluent of artificial origin allowed to rivers and streams, and a 3°F. rise due to heated effluent for the epilimnion of lakes.

Narrative Statement: No heated effluent allowed to be discharged in the vicinity of, or so as to affect, waters designated as fish spawning beds by the State.

Tidal Waters: No discharge of heated effluent that will raise the monthly mean of the maximum daily temperature

outside mixing zones of more than 4°F. or, where the necessity therefor in any specific location is shown to exist, more than 1.5°F. during the months of July, August, and September.

Maryland: F & WL -

Nontidal waters:

Trout waters - not to exceed 72°F. at any time. All other waters - not to exceed 93°F., elevation of temperature not to exceed 20°F. or 10°F. depending whether the natural water temperature is below or above 50°F., respectively, with a maximum of 60°F. and 93°F., respectively

Tidal Waters: 90°F. max.; same temperature change limit as above with absolute max. temperatures of 60°F. and 90°F.

For all waters not classified for F& WL, no adverse temperature change and max. of 100°F.

Massachusetts: Class A (excellent) - no increase other than natural origin.

Class B (Rec., F & WL)) No increase except where temperature will not exceed
Class C (F & WL)) the recommended limit on the most sensitive receiving water use and in no case exceed 83°F. in warm water fish, and 68°F. in cold water fish, or in any case raise the normal temperature more than 4°F.

Class D (Ind.) - no increase to exceed limits on most sensitive use and in no case exceed 90°F.

All coastal and marine waters - no increase to exceed limits on most sensitive water use.

Michigan: PWS - 10°F. allowable rise above natural temperatures.

Ind. - same as PWS

Rec. - 90°F. max.

F & WL - Cold water fish - 70°F. max., 10°F. change limit*

Intolerant - 85°F. max, 10°F., or 15°F. change limit*
Tolerant - 87°F. max, 10°F., or 15°F. change limit*

Nav. - same as PWS

Minnesota: F & WL & Rec. - 2A - no material increase
2B - 86°F. max
2C - 90°F. max.

Ind. - 3A - 75°F. max.
3B - 86°F. max.
3C - 90°F. max.

Mississippi: Shall not be increased more than 10°F. above the natural prevailing background temperatures, not to exceed a max. of 93°F. after reasonable mixing.

(Temperature change not approved for F & WL)

Missouri: Effluent shall not elevate or depress the average cross-sectional temperature of the stream more than 5°F. The stream temperature shall not exceed 90°F. due to effluents (for most streams).

Trout waters - Effluents shall not elevate or depress the average cross-sectional temperature of the stream more than 2°F.

Lakes and reservoirs - no temperature increase due to any discharge which may be a source of heat.

Montana: PWS - no allowable change to naturally occurring water temperature.

Salmonid fish - increases - 32°F to 67°F. - 2°F max.;
(Classes D1 and D2) above 67°F. - 0.5°F. max.
decreases - over 55°F. - 2°F. max./hr.;
55°F. to 32°F. - 2°F. max., provided that water temperature must be below 40°F. in the winter season and above 44°F. in the summer season.

Non-salmonid fish -
(Class D-3) increase - 32°F. to 85°F. - 4°F. max.; above 85°F. - 0.5°F. max.
decreases - same as Salmonid fish.

Ind. - no allowable temperature change in sufficient quantities to adversely affect the use indicated.

Nebraska: PWS - 5°F. change limit, May-Oct.; 10°F. change limit, Nov.-April; limit of 2°F./hr.

Rec. - same as PWS

Trout Streams - 65°F. max., 5°F. change limit

Warm water streams - 90°F. max., change limits same as PWS

Missouri River (Gavins Point Dam to Sioux City, Iowa) - 85°F. max.; 4°F. change limit

Nevada: Max. summer values - 30°C. to 20°C. (varies with stream)
Max. winter values - 14°C.

New Hampshire: Temperature criteria applicable to New Hampshire waters are those set forth in Section 3, pages 28 through 110, of the National Technical Advisory Committee Report "Water Quality Criteria," and in the official standards of the New England Interstate Water Pollution Control Commission.

New Jersey: FW-1 - preserve natural conditions
FW-2 - (PWS) - 5°F. change limit up to max. of 87°F. (unless due to natural stream temperature)
FW-3 - (F & WL) - same as FW-2
(change limits not approved for FW-2 & FW-3)

Coastal and Tidal waters - no increase that will adversely affect biota *

Delaware Bay and Estuary - 5°F. change limit above temperature gradient (daily avg.) for 1961-1966, or a max. of 86°F., whichever is less.

New Mexico: Warm water fish. - 93°F. max., 5°F. change limit.
Cold water fish. - 70°F. max., 2°F. change limit.
Allowable rise of 9°F. for the lower reach of the Pecos River.

New York: Trout waters - no thermal discharge which will cause adverse affects on trout.

Non-trout waters - 90°F. max. within mixing zone; 86°F. max., and 5°F. change limit outside mixing zone, plus a 2°F. max. change limit/hr., and/or 9°F. max. change limit for a 24 hr. period. (fresh waters)

86°F. max. and 5°F. change limit outside mixing zone, plus a 1°F. max. change limit/hr. and/or 7°F. max. change limit for a 24 hr. period (tidal waters).

North Carolina:	Class A-II (PWS) Class B Class C	5° change limit, maximum of 84°F. for the mountains and upper piedmont, maximum of 90°F. for lower piedmont and coastal plain. Natural trout waters shall not exceed 68° and shall not be significantly increased as a result of the discharge of heated liquids. Put-and-take trout waters shall not exceed 70°F. and may be increased 3°.
	Class D	Not to exceed 5°F. above natural, maximum of 84° in mountains and upper piedmont, and maximum of 90°F. in lower piedmont and coastal plain.
	Class SA(Shell.)	Allowable rise of 1.5°F. during June, July, and August, 4.0°F. remaining months. Not to exceed 90°F. due to the discharge of heated effluents.

North Dakota: 90°F. maximum all waters.

Maximum allowable rise is 5°F. above natural.

Ohio: Aquatic Life A - not to exceed 93°F., May-Nov.; not to exceed 73°F., Dec.-April *

Aquatic Life B - not to exceed 95°F.

Ind. - not to exceed 95°F.

Oklahoma: 5°F. change limit, provided the max. man-made temperature does not exceed 70°F. in trout streams, 75°F. in smallmouth bass streams, or 93°F. in warm water streams.

Oregon: General statement that no measurable increase in temperature allowed when the receiving water temperature is 64°F. or above, or more than 2°F. increase when the receiving water temperature is 62°F. or less. The exceptions follow:

Multnomah Channel and main stem Willamette River, from mouth to Newberg (RM 50): 70°F. and 68°F., respectively.

Main stem Willamette River from Newberg to confluence of Coast and Middle Forks (R.M. 187): 64°F. and 62°F. respectively.

Main stem Columbia River, main stem Grande Ronde River, Walla Walla River: 68°F. and 66°F., respectively.

Goose Lake. 70°F. or the daily mean ambient air temperature, whichever is greater.

Klamath River: 72°F. and 70°F., respectively.

Marine waters: no significant increase above natural background temperature or water temperatures to be altered to a degree which creates or can reasonably be expected to create an adverse effect on fish or other aquatic life.

Pennsylvania: Trout waters 58°F. max., 5°F. change limit.
Warm water Fish. - 5°F. change limit above natural or 87°F. max., whichever is less; 2°F. change limit per hour.

Delaware River Estuary - same as warm water fish., but with 86°F. max.

Mahoning River 93°F. max.; 2°F. change limit per hour.

Puerto Rico: SA - no change)
SB (Shell.))
SC (Rec.)) 93°F. max., 4°F. change limit
SD (F & WL))
SE (Ind.))

Rhode Island: Class A (Excellent) - no increase from other than natural origin.

Class B (Rec.)) 68°F. and 83°F. max. for cold
Class C (F & WL)) and warm water fish., respectively; 4°F. change limit.

Class D (Nav. & Ind.) - 90°F. max., no increase to exceed limits on most sensitive use.

Class SA (Shell.))
Class SB (Bathing)) No increase over the recommended limits for the most sensitive use.
Class SC (Shell. habitat))
Class SD (Nav.))

South Carolina: Class AA(PWS))
Class A (Red.)) 93.2°F. max. in mixing zone;
Class B (treated PWS)) 10°F. change limit. Must be
Class C (F & WL)) unheated zone for fish passage.*
Class C_a (fish survival))

Class SA (Shell.)) fall, winter, spring, no more than
Class SB (Bathing)) 4°F. above natural; summer, no
Class SC (Crabbing)) more than 1.5°F. above natural.

South Dakota: Cold water permanent fish. - 68°F. max., 4°F. change limit.

Warm water permanent fish. - 85°F. max., 4°F. change limit.

Warm water semi-permanent - 90°F. max., 8°F. change limit.

Tennessee: PWS) 93°F. max., 3°F. change limit per hour; in no
Rec.) case shall the temperature rise more than 10°F.
Ind.) above natural - as measured at an upstream point.

F & WL - same as above but with 68°F. max. for trout*

Stock watering & Nav. - no increase other than from natural origin.

Texas: Canadian River Basin - 93°F. max., 5°F. change limit.

Tidal waters - fall, winter, and spring, not to exceed a 4°F. rise; summer - not to exceed a 1.5°F. rise

All other waters - 96°F. max., 5°F. change limit (until adequate stream study is made)

Utah: Cold water fish. - 68°F. max., 2°F. change limit.
Warm water fish. - 80°F. max., 4°F. change limit.

Vermont:
Class A (PWS) - no increase other than natural
Class B (Rec.) -)68°F. and 83°F. max. for cold and
Class C (F & WL) -)warm water fish., respectively;
no increase over 4°F. (cold water criteria not approved)
Class D (Ind.) - 90°F. max. or not harmful to assigned uses.

Virginia: Rules with General State-Wide Application:

The areas in lakes and impoundments of significance to aquatic organisms shall not be raised more than 3°F. above that which existed before the addition of heat of artifical origin. The increase will be based on the monthly average of the maximum daily temperature. Unless a special study proves that a discharge of heated effluent into the hypolimnion (or pumping water from the hypolimnion for discharging back into the same water body) will not produce adverse effects, such practices shall not be approved.

Maximum temperature standards for these waters will be consistent with those of areas upstream and downstream.

2.01 Primary Classification of Waters Within the State

MAJOR CLASS	GEOGRAPHICAL AREA or OTHER DESCRIPTION of WATERS	TEMPERATURE OF Rise Above Natural	Maximum
I	Open Ocean (Seaside of the Land Mass)	4.0(Sept.-May) 1.5(June-Aug)	-- --
II	Estuarine (Tidal Water - Coastal Zone to Fall Line)	4.0(Sept.-May) 1.5(June-Aug)	-- --
III	Free Flowing Streams (Coastal Zone and Piedmont Zone to the Crest of the Mountains)	5	90

IV	Mountainous Zone	5	87
V	Put and Take Trout Waters	--	70
VI	Natural Trout Waters	--	70

Special Standards:

Temperature standard to be established for lakes and impoundments receiving thermal discharges:

> In lakes and reservoirs, the temperature of the epilimnion, in those areas where important organisms are most likely to be adversely affected, shall not be raised more than 3°F. above that which existed before the addition of heat of artifical origin. The increase is to be based on the monthly average of the maximum daily temperature. Unless a special study shows that a discharge of a heated effluent into the hypolimnion (or pumping water from the hypolimnion for discharging back into the same water body) will be desirable, such practice shall not be approved.

Portions of interstate streams shared with the State of West Virginia not classified for trout would match the State's temperature requirements of a maximum of 81°F. and an allowable rise of no more than 5°F.

Virgin Islands: Class A (preservation of natural phenomena) - no change. Class B (Rec. & F & WL) - 90°F. max.; fall, winter, spring - 4°F. allowable rise; spring 1.5°F. allowable rise.

Washington: Class AA (extraordinary waters) - No measurable increases in temperature permitted within the waters designated which result in water temperatures exceeding 60°F. (Fresh water) or 55°F. (Marine water) nor shall the cumulative total of all such increases arising from nonnatural causes be permitted in excess of $t=75/(T-22)$ (Fresh water) or $t=24/(T-39)$ (Marine water); for purposes hereof "t" represents the permissive increase and "T" represents the resulting water temperature.

Class A (excellent waters) - 65°F. and 61°F. max. for fresh and marine waters, respectively. $t=90/(T-19)$ and $t=40/(T-35)$ for fresh and marine waters, respectively.

Class B (good waters) - 70°F. and 66°F. max. for fresh and marine waters, respectively. t=110/(T-15) and t=52/(T-32) for fresh and marine waters, respectively.

Class C (fair waters) - 75°F. and 72°F. max. for fresh and marine waters, respectively. t=125/(T-12) and t=64/(T-29) for fresh and marine waters, respectively.

Wisconsin: F & WL - in waters where this use is of primary importance - 84°F. max., 5°F. change limit, 2°F. change limit per hour. Where fishing is an additional use - 89°F. max., 5°F. change limit. In addition, authorization is required for proposed installations where thermal discharges may increase natural temperature by 3°F.

Trout streams - no temperature change that will adversely affect trout.

Ind. - 89°F. max.

West Virginia: Class B2 (Ind.) - safe fish passage required
Class C (F & WL) - not to exceed 93°F. May-Nov.; not to exceed 73°F. Dec.-April; 5°F. rise limit; 2°F./hr change rate.
Class D (cooling) - same as Class C
Class E (waste transport) - fish passage required

Wyoming: Streams where natural temperatures exceed 70°F., 4°F. change limit over natural.

Streams where natural temperatures are less than 70°F., 2°F. change limit over natural.

(Until study is made, Max. temperature limit is daily average plus allowable rise.)